

2020 Flagstaff Community Greenhouse Gas Emissions Report

Executive Summary

The Flagstaff community contributes to climate change by releasing greenhouse gas (GHG) emissions - carbon dioxide (CO₂), methane (CH₄), nitrous oxides (N₂O), and others - that trap heat inside the atmosphere. Climate change occurs when the concentration of greenhouse gasses inside the atmosphere increases.

Reducing our contribution to climate change means reducing our greenhouse gas emissions, which starts with knowing where we are now. GHG emissions reporting helps us measure the impact of the Flagstaff community's activities so that we can:

- Understand the scale of our GHG emissions and what activities cause them,
- Identify what types of actions the City and community can take to reduce Flagstaff's GHG emissions, and
- Track our future progress as we work to implement the Flagstaff Climate Action and Adaptation Plan (CAAP) and Carbon Neutrality Plan (CNP).

This report presents the GHG inventory of 2020 and places the CAAP and CNP emission reduction goals into context. The inventory results show that most of Flagstaff's GHG emissions continue to come from driving cars and powering buildings, and finds that our community emissions have been increasing over time along the expected business as usual scenario.

2016 - 2020 Emissions

It should be highlighted that the emission values for the 2019 inventory in this report includes one amendment as compared to the 2019 Community Emissions Report that was published in 2020. This update, its reasons and implications are outlined in Table 1.

Table 1. Explanation of amendment to the 2019 inventory in this report

Note: Amended 2019 Inventory (Methodology Reversion)	
Previous Method:	Methane Commitment Method (Used in the 2019 Community Emissions Report)
New Method:	Landfill Method
Explanation:	In this report, the solid waste emissions for the year 2019 were re-calculated using the 'landfill method' - this is a reversion to the method that was used for the 2016 and 2018 inventories. The method used in the 2019 Community Emissions Report, referred to as the 'methane commitment method,' calculated both the current-year emissions of the total volume of waste sent to landfill and the future emissions that would be released as the material degraded over time. In this way, the annual community-generated emissions would be a higher value, however, this method would lead to a greater reduction once pollution control measures were introduced to the Cinder Lake landfill. The 'landfill method' used in 2016, 2018, and now 2020, relies on the methane emissions that were released in the calendar year of the inventory. This method was reestablished in order to solely track the emissions generated within the time boundary of an inventory, which is a calendar year.
Implications:	In all instances of year-to-year comparison, the amended 2019 inventory value will be used in this report. This is reflected in the tables and figures in this report. Figure 5 includes the 'bar-on-bar' visualization, and is the only graphic that shows both methods, with the methane commitment total represented by a smaller-width, black bar. The amended 2019 total (landfill method) retains the originally-formatted, yellow bar.

Greenhouse Gas Emissions, by Sector

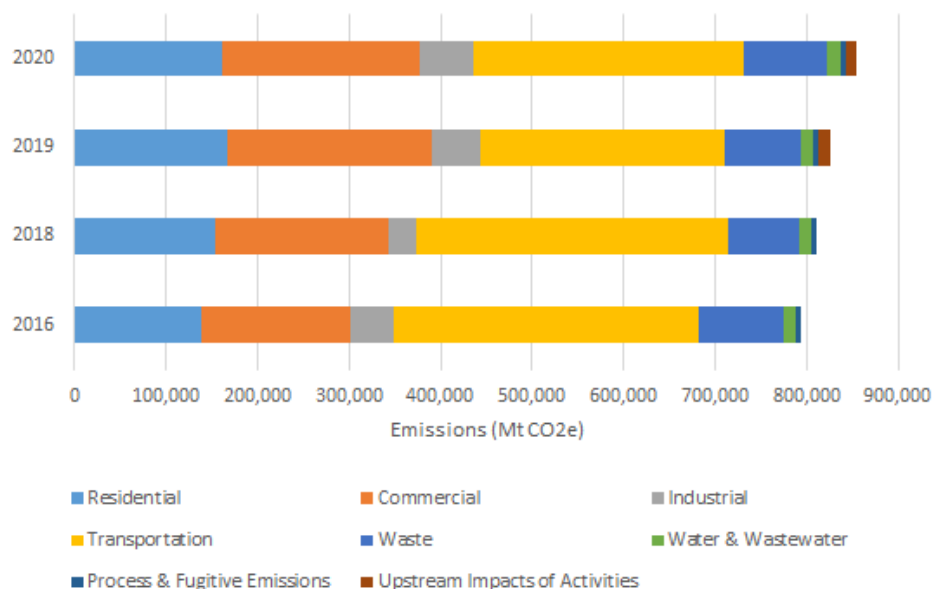


Figure 1. Horizontal bar graphs comparing 2016, 2018, 2019, and 2020 inventory results by sector. The 2019 value contains the amended total (explained in Table 1).

In 2016, the City of Flagstaff's total community emissions were 794,135 metric ton carbon dioxide equivalent (Mt CO2e), as illustrated in Figure 1 and Table 2.¹ In 2020, our community emissions increased approximately 8% compared to 2016 and increased approximately 4% compared to 2019.

Table 2. Sector emissions for 2016, 2019, and 2020 in Mt CO2e. The 2019 column includes the amended total for waste emissions based on the updated methodology (Table 1).

	2016	2020	Change	2019	2020	change
City Population	71,455	76,338	5%	75,038	76,338	2%
City GDP	\$7,016M	\$7,887M	10%	\$7,718M	\$7,887M	2%
Residential Energy Emissions	138,472	162,035	17%	167,009	162,035	-3%
Commercial Energy Emissions	163,107	214,260	31%	222,819	214,260	-4%
Industrial Energy Emissions	46,617	59,067	27%	54,021	59,067	9%
Transportation Emissions	334,858	295,088	-12%	267,452	295,088	10%
Waste Emissions	92,648	90,963	-2%	81,842	90,963	11%
Water & Wastewater Emissions	11,954	15,343	28%	13,393	15,343	15%
Process & Fugitive Emissions	6,479	6,443	-1%	6,542	6,443	-2%
Upstream Impacts of Activities	NA	12,205		12,269	12,205	-1%
Total	794,135	855,403	8%	825,347	855,403	4%

Note: NA stands for "not accounted"

¹ Metric ton carbon dioxide equivalent (Mt CO2e) serves as a standard unit for greenhouse gases, indicating the impact of different greenhouse gases in terms of the amount of CO2 that would create the same amount of global warming. For example, methane has 28 times the impact of carbon dioxide in the atmosphere, so 1 metric ton of methane would equal 28 Mt CO2e.

The 8% **increase** in emissions from 2016 to 2020 should be considered with the following factors in mind:

- The population and GDP in Flagstaff increased by 5% and 10%, respectively, over the same period.
- In 2019 and 2020 the treatment of daily vehicle miles traveled (VMT) was updated, resulting in a net reduction in transportation emissions, by accounting only for internal vehicle miles traveled. Previously “through trips” had been included in the inventory. The use of the internal VMT metric is consistent with the VMT reported in the Annual Reports for the Regional Plan. The table below shows the Internal VMT over time as reported in the Regional Plan Annual Reports.

Year	Daily Internal VMT	% Change from previous year
2014	1,474,767	-
2015	1,524,069	3.3%
2016	1,537,765	0.9%
2017	1,604,288	4.3%
2018	1,615,410	0.7%
2019	1,594,818	-1.3%
2020	1,740,832	9.2%

- Starting in 2019, and continued into 2020, contractual natural gas was included in the community inventory. Since a sector breakdown for this contractual natural gas could not be provided at this time, for accounting purposes it was split 50:50 between the commercial and industrial sectors. Thus, both sectors saw an increase in emissions. If a more targeted sector accounting can be provided in future years, this approach will be updated. The table below shows the total amount of natural gas delivered to the community, as reported by Unisource.

Year	Total Therms Delivered	Total Therms Reported in Inventory	% Change from Previous Inventory
2016	37,344,272	25,161,607	
2018	28,825,232	25,648,017	2%
2019	37,708,414	37,708,414	32%
2020	37,137,517	37,137,517	-2%

- Starting in 2019 and continuing into the future, upstream impacts of activities (mainly losses from power transmission and distribution) were incorporated, increasing overall emissions.

The 4% **increase** in emission from 2019 to 2020 should be considered with the following factors in mind:

- Due to constraints of when data becomes available for the on-road VMT model, the transportation sector always reports fiscal year rather than calendar year data for the annual greenhouse gas inventory. This means that the 2020 inventory includes VMT data from July 2019 to June 2020. While most years this data lag has a relatively nominal impact on the inventory, it should be noted that the VMT data reported here only includes data from the first three to four months (March 2020 – June 2020) of the COVID pandemic, and not the nine to ten months that might be expected. Additional impacts of the pandemic with regard to transportation might be observed in the 2021 report. Note: All other sector data reflects the calendar year 2020 community activities.

Emissions by Sector

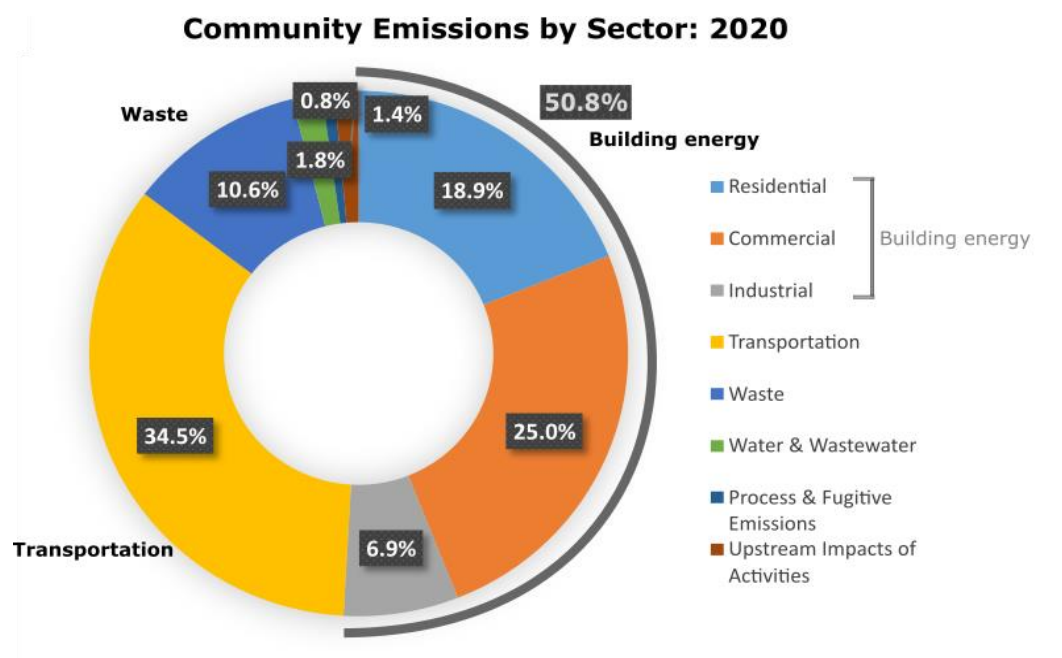


Figure 2. Sector breakdown for community emissions generated in 2020

Figure 2 illustrates that 85.3% of Flagstaff's community emissions come from just two sectors:

- **Building Energy** (50.8%), which represents emissions coming from the use of electricity and natural gas, in our homes, commercial and industrial buildings. The majority of building energy emissions are split between commercial and residential buildings.
- **Transportation** (34.5%), which is from the fuels, like gasoline and diesel, that we use to get around town.
- While smaller relative to other sectors, the emissions from solid waste (10.6%), water and wastewater treatment (1.8%), upstream impacts of activities (1.4%), and process and fugitive emissions (0.8%) are all important to measure and manage in order to achieve our emissions reduction goals.

Flagstaff's Emissions over Time

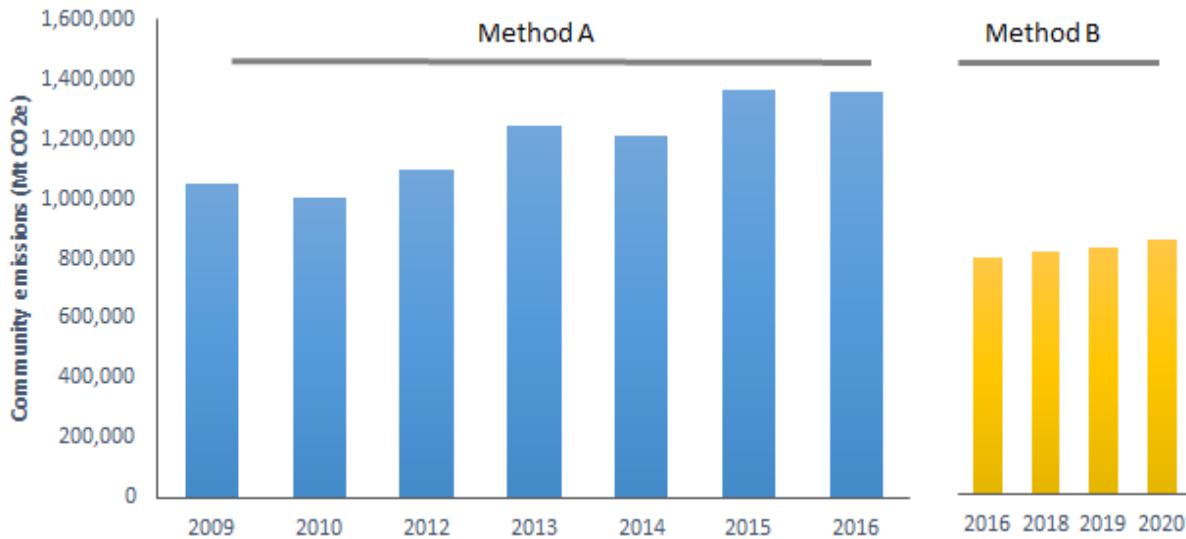


Figure 3. Total annual community emissions for years 2009-2016 using method A (in blue), and for years 2016-2020, using method B (in yellow). The 2019 total represents the amended value (Table 1).

The City of Flagstaff has been tracking community greenhouse gas emissions since 2006. Since then, the way we track emissions has evolved. While the City has tracked similar sectors of emissions over time, the methodologies used to track these emissions has changed significantly. Though global and national greenhouse gas emissions have been measured for decades, the first Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) was only launched in 2014. The establishment of this global standard for community level greenhouse gas inventories created a reliable methodology that now helps Flagstaff compare its emissions to other communities. Prior to 2016, the City tracked emissions using the draft International Local Government Greenhouse Gas Emissions Analysis Protocol (IEAP), referred to as Method A in this report. From 2009 to 2016, the general trend observed was of steadily increasing community emissions (see Figure 3).

As part of the development of Flagstaff's Climate Action and Adaptation Plan, the City began using the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. For the 2016 inventory, the City transitioned from Method A to the U.S.-specific counterpart to the GPC framework, the U.S. Community Protocol, referred to as Method B in this report. Method B was used for the 2016, 2018, 2019, and 2020 GHG inventories. The baseline emissions for our community in the Climate Action and Adaptation Plan, as well as the associated emissions reduction goals, are entirely based on the 2016 inventory that was completed using the standardized U.S. GPC method – method B. To compare the two methods, the City of Flagstaff performed two community level greenhouse gas inventories in 2016 - one using method A and one using method B. This comparison illustrated that:

- Method A had likely been overestimating our total community emissions.
- In particular, Method A had a less sophisticated protocol for calculating vehicle emissions within a community. While the reported values for the total community emissions in Flagstaff before 2016 are likely to be over-calculated compared to the new standardized protocol, the observed trend of steadily increasing community emissions between 2009 and 2016 would remain regardless of the method used.

Due to the significant differences in techniques between method A and method B, it is difficult to compare community emissions across all inventory years. However, community emissions increased over time using both inventory methods - between 2009 and 2016, as well as between 2016 and 2020. This trend of increasing emissions is mirrored in communities across the US.

Emissions and the CAAP & CNP goals

The Flagstaff Climate Action and Adaptation Plan (CAAP) established a goal to reduce Flagstaff community emissions by 80% by 2050, with interim goals of 15% reduction by 2025 and 30% reduction by 2030, based on a baseline measurement of emissions in 2016. The Flagstaff Carbon Neutrality Plan (CNP) was developed as an update to the CAAP, replacing the emission reduction goals with a 44% emission reduction by 2030 based on the business-as-usual (BAU) estimation for 2030. Although the CNP replaces the emission reduction goals established by the CAAP, it still draws on its elements of adaptation and equity. The update to the emission reduction targets reveals Flagstaff's increasingly aggressive commitment to the reduction of community emissions (Figure 4).

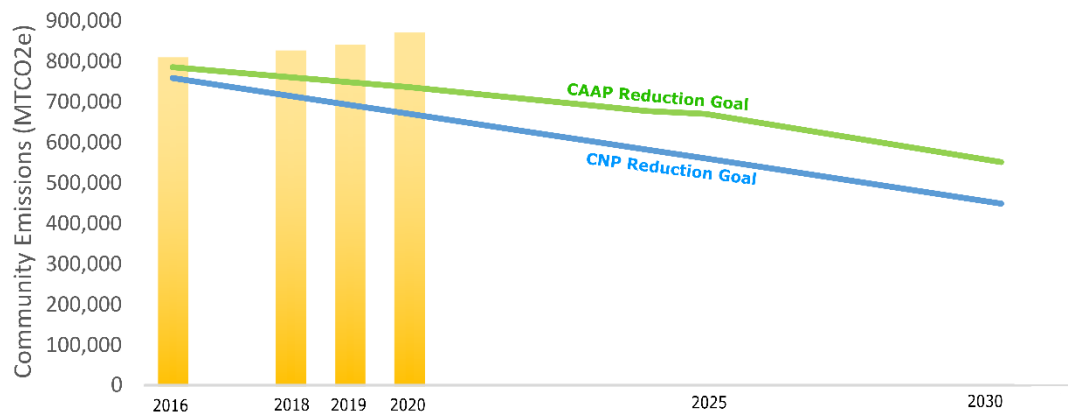


Figure 4. Diagram showing the CNP reduction target trendline versus the previous CAAP reduction target trendline and the emission inventory results for 2016, 2018, 2019 (amended), and 2020.

Proceeding into the future, annual community emissions data will be compared alongside the CNP reduction goals. One way to track our progress against this goal is by using a "wedge" diagram (Figure 5). The wedge uses the 2016 BAU estimated baseline emissions as the starting point and models two possible future outcomes:

- A business as usual (BAU) scenario where no action is taken to reduce community emissions. In the BAU scenario, emissions steadily rise in conjunction with projected community and economic growth. This would mean a projected 11.5% increase in Flagstaff-caused emissions by 2030 (Table 3).
- An emissions reduction scenario where Flagstaff takes aggressive climate action and reduces emissions by 44% from the 2016 BAU baseline estimate by 2030.

The 'wedge' is the difference between the two scenarios, and represents the emissions reductions needed to meet our goals. Our emissions in 2020 exceed the business as usual scenario. As the City of Flagstaff continues to conduct annual greenhouse gas inventories, we will plot the outcomes of these

inventories onto the wedge diagram. This will help us track our progress towards our emissions reduction goals.

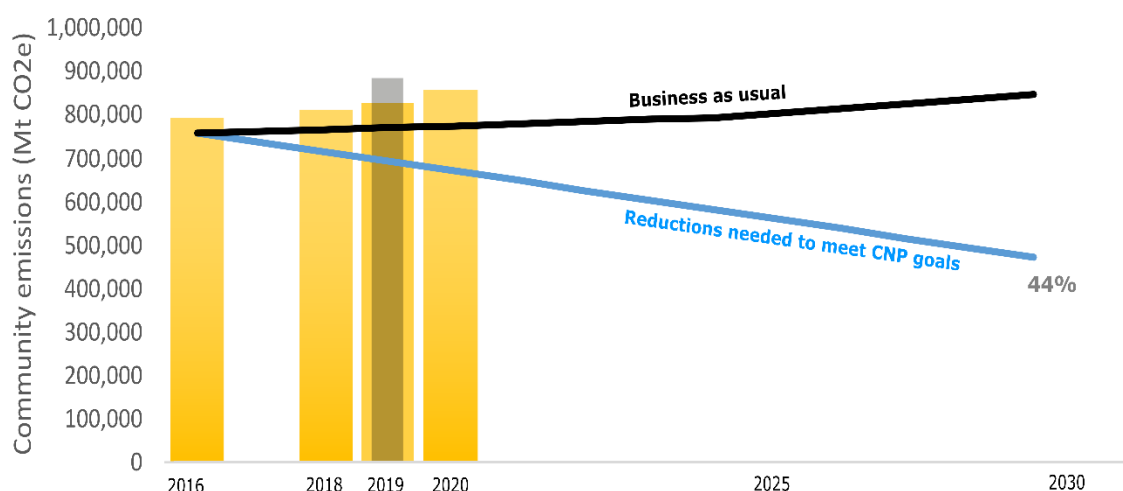


Figure 5. Wedge diagram showing the business as usual future projection (black line), the future with reductions in emissions (blue line), and the emission inventory results for 2016, 2018, 2019 (amended), and 2020 (yellow bars). The low-opacity, (black bar) represents the 2019 emission total produced in the 2019 Community Inventory Report, which used the methane commitment method (Table 1).

Table 3. Future emission scenarios and the CNP goal as per the 2016 BAU baseline.

Performance Indicator	2016 BAU Baseline Estimate	2020 Emissions	2030 Target (44% reduction)
Community emissions (Mt CO2e)	758,796 ²	855,405	471,619

How will we get there?

Achieving a 44% reduction by 2030 will require significant change from everyone in the Flagstaff community. The major changes identified by the CNP are:

- Collection and flaring of landfill gas (methane) by installing appropriate landfill systems
- Maintain 2019 VMT levels, as well as assume 30% of internal travel will be lower-emitting, electric vehicles in 2030 and, therefore, reduce our community transportation emissions
- Reduce total City of Flagstaff (municipal) energy use by 28%, natural gas use by 60%, and by using 100% zero-emission electricity
- Reduce total residential energy use by 43%, natural gas use by 62%, and by using 72% zero-emission electricity

² The CNP initiated a new calculation for the 2016 BAU baseline emissions value, which accounted for the new transportation method that accounts for internal VMT, rather than total VMT (what was done in the 2016). So, rather than use 787,315 Mt CO2e (or 794,135 Mt CO2e), the baseline for 2016 is 758,796 Mt CO2e. This was done due to the fact that the reduction goal is based on the BAU baseline, rather than inventory-calculated emissions.

- Reduce total commercial energy use by 11%, natural gas use by 20%, and by using 69% zero-emission electricity
- Ensure the adoption of industrial electricity use to 69% zero-emission electricity

By 2030, the strategies in the CNP will lead to a reduction in community emissions by 44%, with the remaining 56% of emissions being removed through a portfolio of near-future sequestration activities or certification and offsetting options, as seen in Figure 6. The CNP outlines specific, actionable steps that will be taken by 2030, especially within the building sector, in order to achieve the 44% reduction:

- 2,000 ‘new home’ solar systems will be installed
- 15 megawatts (MW) of new solar will be installed on commercial/industrial properties
- 50% of residential, and 25% of commercial, buildings will complete an energy efficiency retrofit
- 15% of commercial buildings will fully electrify
- 100% renewable electricity for municipal buildings by 2025
- Use of net-zero energy use in new buildings

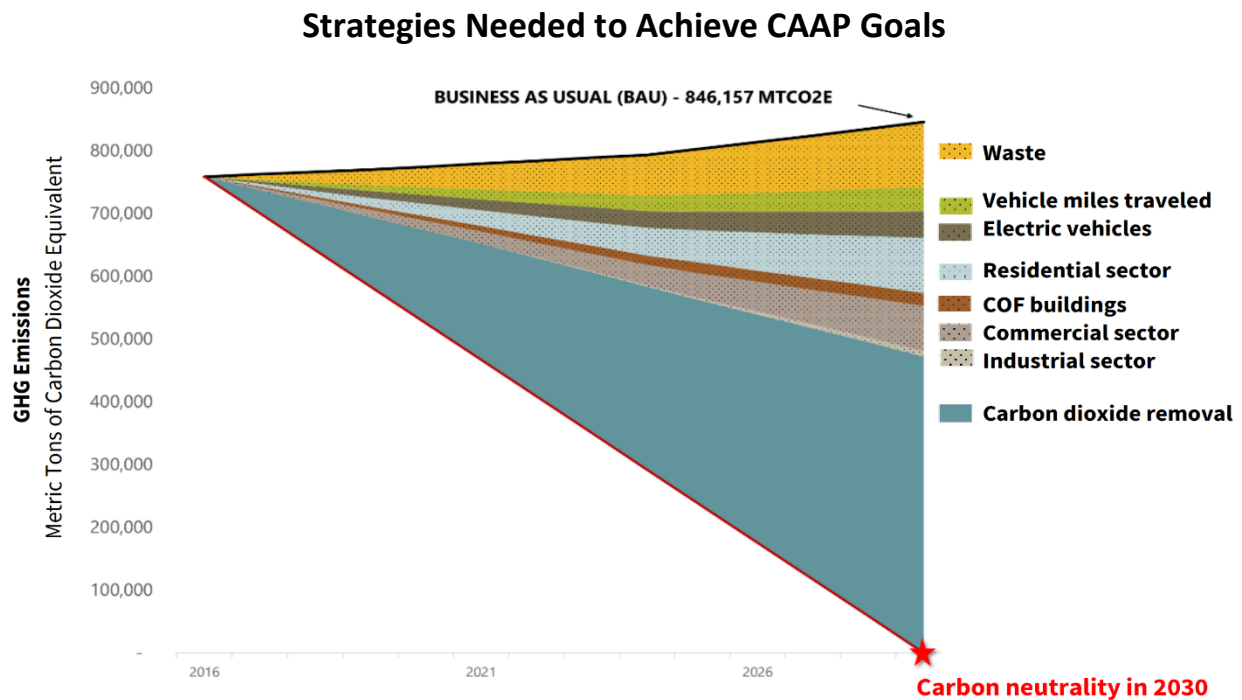


Figure 6. Wedge diagram developed with the CNP and showing the emission reductions within the major emission categories in order to achieve carbon neutrality by 2030.

Emissions by Scope

Emissions can also be reported by scope, which categorize emissions by their source and owner. Scope 1 represents emissions from sources located in the city boundary, scope 2 represents emissions from the use of grid-supplied energy within the city boundary, and scope 3 represents all other emissions that occur outside the city boundary as a result of activity within the city (Figure 7).

Since 2009, the City of Flagstaff Community Greenhouse Gas Inventory has included scope 1 and 2 emissions. Scope 3 emissions are a new component, beginning with the 2016 inventory (Figure 8). In 2019, emissions from power distribution and transmission losses were added for the first time. Current accounting of scope 3 emissions is not comprehensive; the amount is an underestimation of the total scope 3 emissions produced by the City. In the future, with each progressive inventory, the City of Flagstaff aspires to further develop the methods and partnerships necessary to incorporate scope 3 emissions more comprehensively.

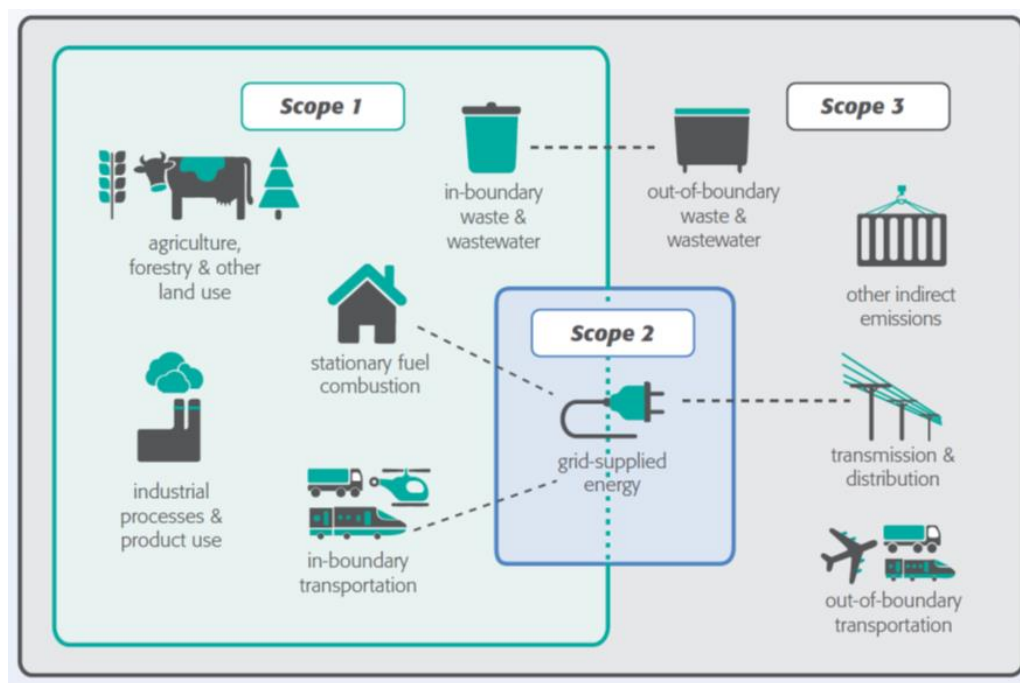


Figure 7. Sources included within each scope. Images from the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

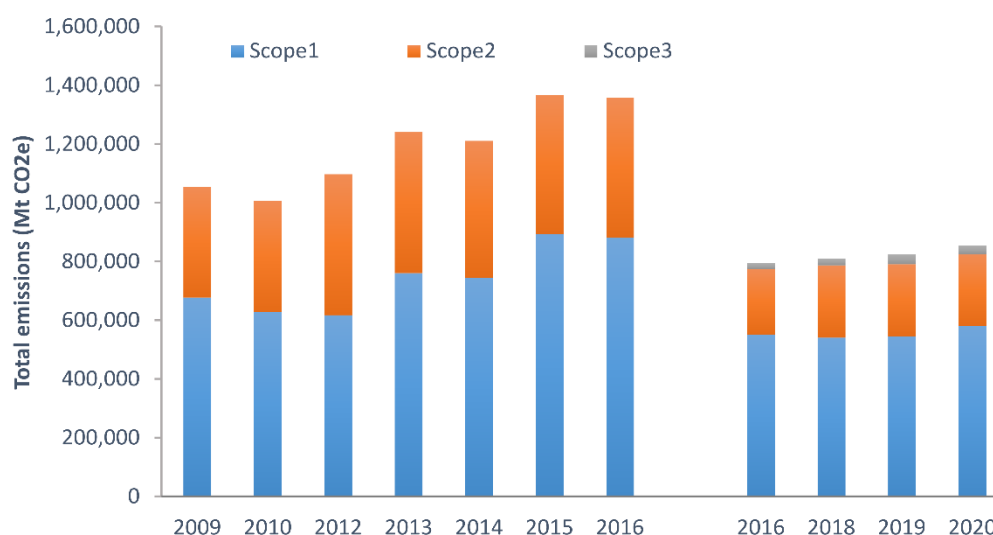


Figure 8. Scope 1 and 2 emissions were estimated for each year, but scope 3 emissions were added to the inventory in 2016, 2018, 2019 (amended), and 2020. Scope 3 emissions are underestimated.